Space Weather Technical Forecast

Issued on Friday, 21 June 2024 at 13:09 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Further M-class flares (R1-R2 radio blackouts) expected. Chance of isolated X-flares (R3 radio blackouts). Chance of S1/Minor radiation storms.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with the peak flare M5.7 at 20/2316 UTC from AR3719. There are currently seven sunspot regions on the disc. The largest region remains AR3712, with limited change in the appearance and orientation of its numerous large spots, and any delta spot appearing to fade. AR3713 has paused in its growth although the main lead and trailer spots now appear to share the same penumbra, with multiple delta configurations evident. AR3716 is largely unchanged with little apparent alteration in appearance and a small delta spot. These three regions appear stable at this time, with limited flaring observed. AR3719, the most active flaring region at present has seen the main lead and trailer spots separate, with negligible new growth. AR3720 also appears broadly similar to the previous analysis. There are signs of two further regions rotating onto both the northeast and southeast limbs, but with a very limited view at present.

No Earth directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds, as observed by ACE at L1, indicated declining fast wind influence from CH45/+. Wind speeds have been slightly elevated, falling from around 480 km/s to near 400 km/s. Density was below average throughout. Interplanetary Magnetic Field, Bt, was weak, below 6nT. The north-south component, Bz, varied weakly between +5/-3nT. Phi angle was predominantly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels with no solar radiation storms occurring. High energy electron flux (greater than 2MeV) observed by GOES16 was predominantly moderate, reaching 561 pfu at 20/1730 UTC. The 24-hour fluence was below Active on a slight rising trend, reaching 1.7e7 integrated pfu at 21/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-flares are expected, with a chance of isolated X-class flares, most likely from AR3712, AR3713, AR3716 and AR3719.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast period, but with lower confidence than usual. Ongoing coronal hole influence should continue to ease on Day 1 (21 Jun) with winds expected to reduce to background levels. A further enhancement from the large coronal hole in the northwest disc is possible on Days 1 and 2 (21 and 22 Jun), however, significant connection to this feature is considered unlikely given its high-latitude location on the disc. If a connection were to be forthcoming, speeds could reach slightly elevated to elevated levels.

Overall mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals, mainly on Days 1 and 2 (21 and 22 Jun), should there be any notable connection to the aforementioned large coronal hole.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at

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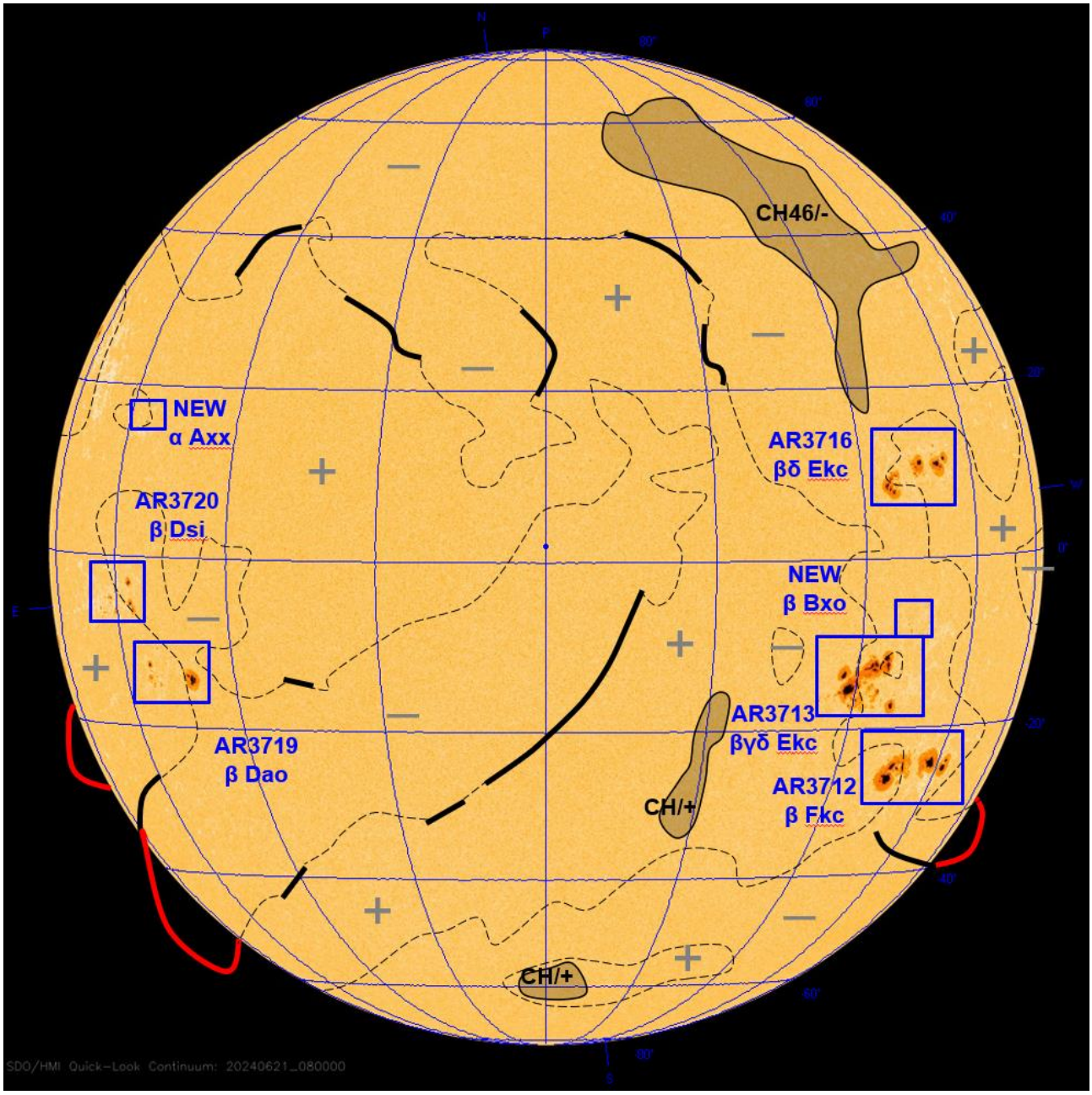
background levels, but with a chance of exceeding the S1/Minor Storm threshold should any notable flares occur, predominantly from any of the three large spots in the western hemisphere. High energy electron flux is forecast to be at mainly moderate levels on Days 1 and 2 (21 and 22 Jun), before likely declining to become predominantly background later in the period. The associated 24-hour fluence is expected to remain below the Active threshold.

Figure 1. Solar Analysis Valid 21/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No obviously Earth directed CMEs have been seen in imagery, although given the number of CMEs in recent days there is some uncertainty in this aspect.

Solar winds are currently slightly elevated due to waning effects of CH45/+, and are expected to continue declining through much of the rest of Day 1 (21 Jun). MOSWOC Enlil is indicating a significant enhancement should already have occurred from large coronal hole, CH46/-, in the northern disc. CH46/- is considered to be over-estimated in both strength and southern extent in Enlil, as well as too early with any potential onset. No significant enhancement was observed from this feature on the previous rotation. However, given the slightly more northward location of Earth above the ecliptic, a minor enhancement may be observed on Days 1 and 2 (21 and 22 Jun). In the case of any connection to this feature, wind speeds would potentially increase to slightly elevated, or perhaps elevated levels, by the end of Day 2 or into Day 3 (22-23 Jun). Either way, any geomagnetic response is expected to be limited at this time of year (around the solstice). No other potential coronal hole enhancements feature in this period.

Overall mainly Quiet to Unsettled geomagnetic activity is expected. There is a chance of isolated Active intervals, mainly on Days 1 and 2, should there be any notable connection to the high-speed stream enhancement from the aforementioned CH46/-.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs are currently expected.

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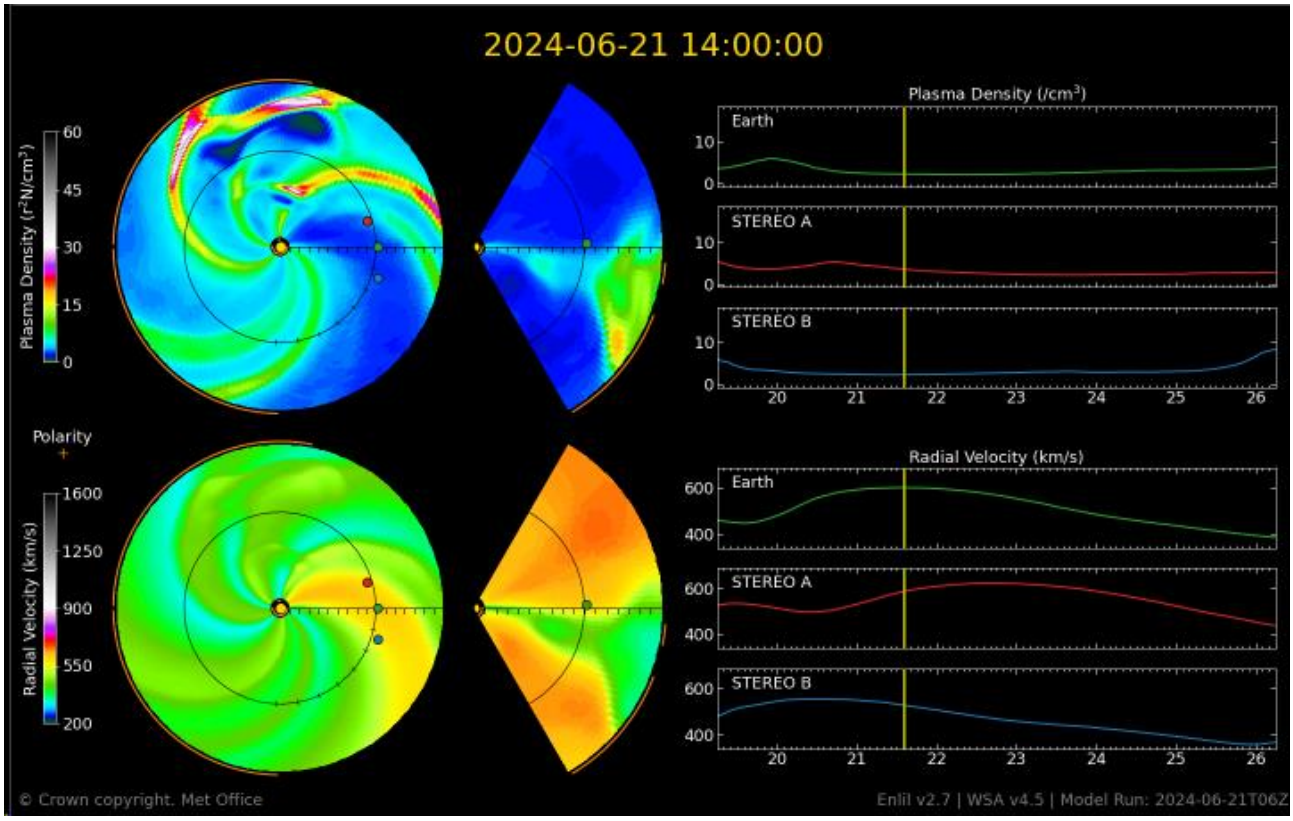
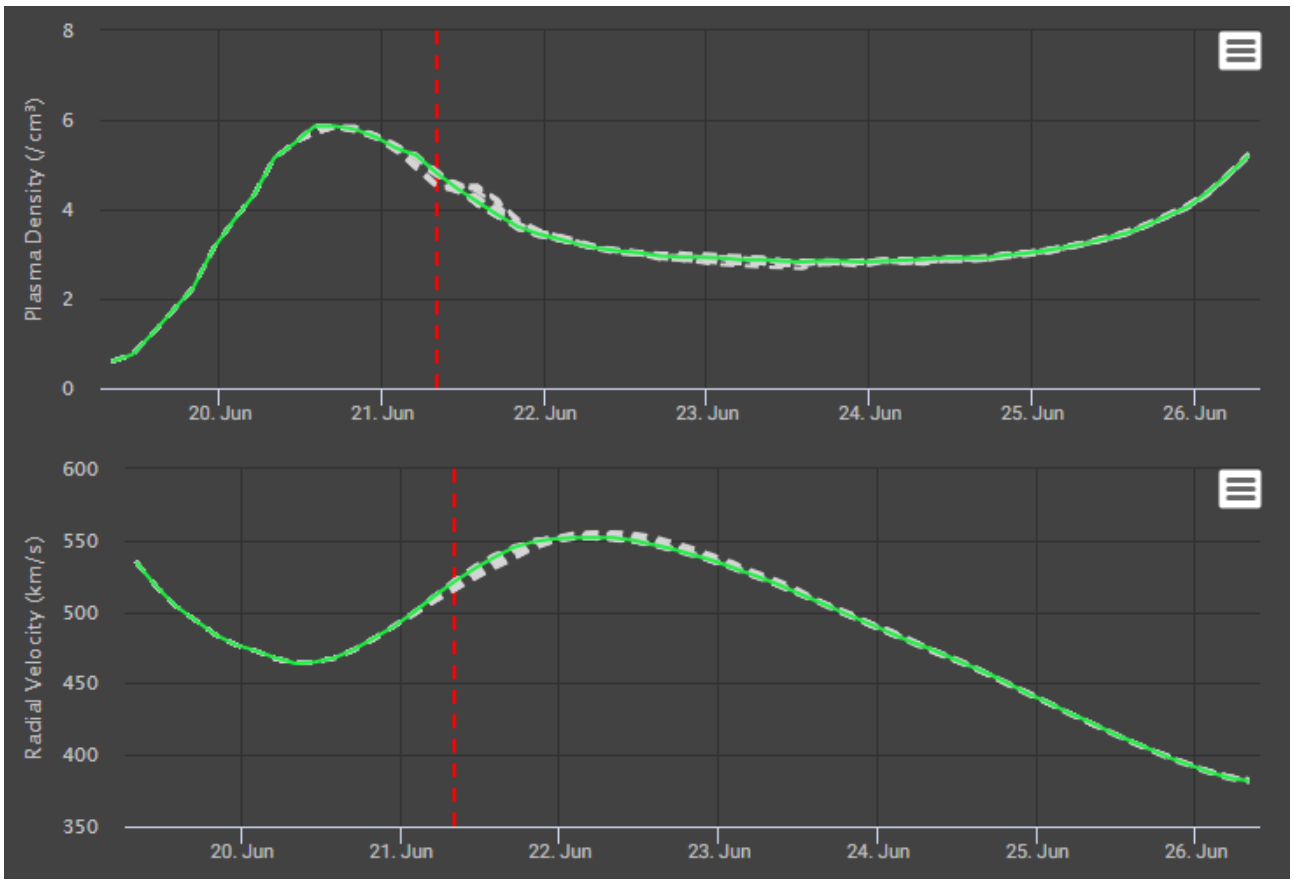
Figure 2: MOSWOC Enlil and ensemble, showing no Earth directed CMEs, but with Enlil over predicting the upcoming possible high speed stream.





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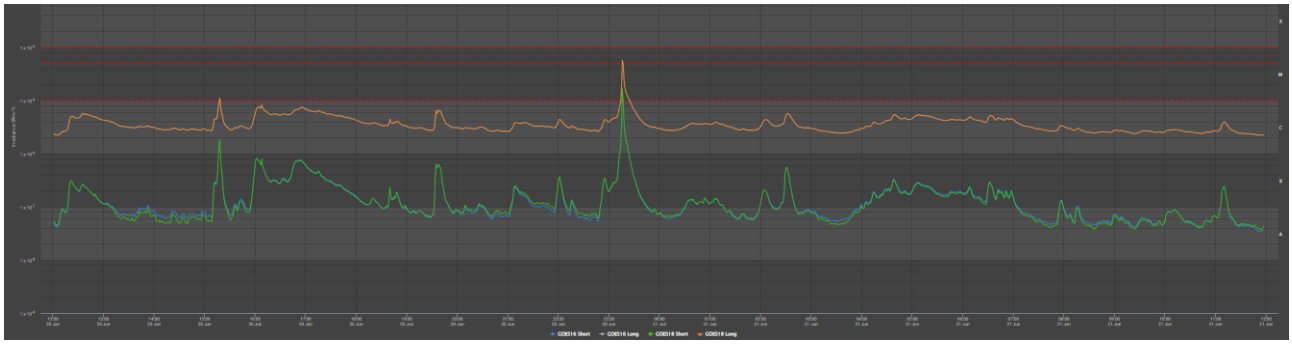
Radio Blackouts - X-Ray Flares:
There are currently seven sunspot regions on the disc, with AR3718 having faded. The largest region remains AR3712 (Fkc/Beta), with limited change in the appearance and orientation of its numerous large spots, and any delta spot appearing to fade. AR3713 (Ekc/Beta-Gamma-Delta) has paused in its growth although the main lead and trailer spots now appear to share the same penumbra, with multiple delta configurations evident. AR3716 (Ekc/Beta-Delta) is largely unchanged with little apparent alteration in appearance and a small delta spot. These three regions appear stable at this time, with limited flaring observed. AR3719 (Dao/Beta), the most active flaring region at present has seen the main lead and trailer spots separate, with negligible new growth. AR3720 (Dsi/Beta) also appears broadly similar to the previous analysis. There are signs of two further regions rotating onto both the northeast and southeast limbs, but with a very limited view at present.

AR3712 and AR3716 are due to rotate off the visible disc on Day 4 (24 Jun), but will still pose a threat for significant flares just beyond the western horizon.

There are a number of potential returning regions in the period. Far-sided seismic data also indicates a region due to return on Day 4 (24 Jun) and is likely Ex-AR3664/Ex-AR3697, although may be significantly altered from when it was last on the visible disc earlier in June.
Further M-class flares are expected, with a chance of isolated X-class flares, most likely from AR3712, AR3713, AR3716 and AR3719.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	25	25	25	25

Figure 3: X-ray flux at GOES16 and 18, with the two M-flares both originating from AR3719.



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Solar Radiation Storms - (High Energy Protons):
GOES-18 proton flux remains at background levels, with no solar radiation storms observed. However, any significant flares, particularly from any of the three larger regions (AR3712, AR3713 or AR3716) in the western disc, have the potential to increase the observed flux and brings a chance of exceeding the S1 Minor Storm threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	30	30	30
Very Active	**≥ S3 ***	No	5	5	5	5

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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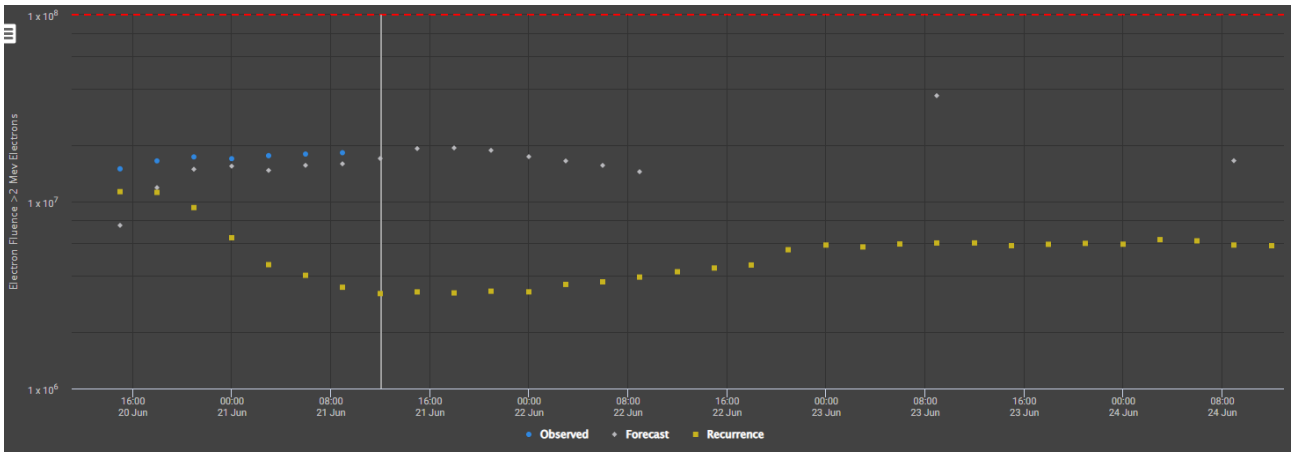
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, reached predominantly moderate levels as a consequence of the relaxation of the Van Allen belts following the fast wind enhancement from CH45/+. Electron flux is likely to continue at mainly moderate levels on Days 1 and 2 (21 and 22 Jun), perhaps briefly reaching high levels at diurnal maxima, before declining later in the period to become mainly background. A more pronounced decline would be expected on Days 1 and 2 should the potential connection to CH46/- be stronger than anticipated.

Despite the recent increase, associated electron fluence is expected to persist below the Active threshold (1e8 integrated pfu), with MOSWOC REFM output considered to be good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REFM, showing a below Active trend, which seems reasonable.



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